

## THE CAUSES OF DISAPPEARANCE OF SWORD LILY GLADIOLUS IMBRICATUS L. FROM NATURAL STANDS- SYNTHESIS OF CURRENT STATE OF KNOWLEDGE

Kinga KOSTRAKIEWICZ-GIERAŁT<sup>1\*</sup>, Cristina Carmen PALICI<sup>2</sup>, Alina STACHURSKA-SWAKOŃ<sup>3</sup>, Valentin NEDEFF<sup>2</sup>, Ion SANDU<sup>4,5</sup>

<sup>1</sup> Department of Natural Environmental Studies, Faculty of Tourism and Recreation, University of Physical Education in Krakow, Jana Pawła II 78, 31-571 Kraków, Poland

<sup>2</sup> Vasile Alecsandri University of Bacau, Department of Environmental Engineering and Mechanical Engineering, 157 Calea Marasesti, 600115 Bacau, Romania

<sup>3</sup> Department of Plant Ecology, Institute of Botany, Jagiellonian University, Gronostajowa 3, 30-387 Kraków, Poland

<sup>4</sup> Alexandru Ioan Cuza University of Iasi, ARheoinvest Platform, Blvd. Carol I, no. 22, G Building, Iasi, Romania

<sup>5</sup> Romanian Inventors Forum, Str. Sf. P.Movila 3, L11, III/3, Iasi, Romania

### **Abstract**

*The sword lily *Gladiolus imbricatus* L. is a clonal plant covering Central and Eastern Europe, the Mediterranean, Caucasia and West Siberia. The aforementioned species is included in numerous national Red Books or Lists due to the progressive decrease of stands. The present paper reviews the factors threatening the occurrence and condition of *Gladiolus imbricatus* populations in natural localities. The largest threat is connected with transformation of meadows and expansion of urban areas.*

**Keywords:** *Sword lily; Natural localities; Population abundance; Threatened species; Molinion.*

### **Introduction**

Progressive anthropopressure is leading to huge changes in the natural environment, which are recognised at various levels of its organisation: they are both global and also locally recognised by changes in the areas covered by particular types of ecosystems, extinction of species and expansion or invasion of new species for a given area. Trends in the contemporary approach to nature conservation as well as the so-called sustainable development are aimed at preserving biodiversity for future generations.

Understanding the causes and mechanisms of the disappearance of plant species is very important because it can enable the taking of appropriate action before a population will reach a critical size. Reductions in the populations of meadow plant species may be the result of changes in the environmental conditions [1-3]; very often it is a consequence of abandoning traditional farming methods [4-6]. Abandonment of traditional use could start a chain of events resulting in stronger competition for various environmental resources or lack of gaps for seeds germinating [7-8]. The occurrence of the species could be also influenced by interaction between plants caused by allelopathins [9]. In addition, plants that have become rare are more susceptible to the interactions that decrease plant fitness, e.g. herbivory, a lack of pollinators etc. The loss of seeds as a result of pre-dispersal seed predation may be a potential threat for the plant population

\* Corresponding author: [kinga.kostrakiewicz@awf.krakow.pl](mailto:kinga.kostrakiewicz@awf.krakow.pl)

maintenance [10-11]. In general, the main reason for the lower population growth rate in rare species is the higher sensitivity to sexual reproduction [12].

Belonging to the group of plant species with a noticed gradual decrease in the number of population is *Gladiolus imbricatus*. It has become a legally protected species in numerous countries inter alia in Poland [13]. Moreover, it is included in the Red Lists or Books of Vascular Plants of many countries such as Belarus [14], the Czech Republic [15], Estonia [16], France [17], Hungary [18], Latvia [19], Switzerland [20], as well as Ukraine [21]. Furthermore, the sword lily is included in 'The Red List of Eastern and Central Europe' [22], as well as 'The Red List of Vascular Plants of the Carpathians' [23].

The present paper reviews several studies on the factors threatening the occurrence and condition of *Gladiolus imbricatus* populations in natural localities. The specific aims were: (i) the survey of natural localities of populations and (ii) the assessment of causes of diminished abundance and performance of individuals.

## Material and methods

### Plant species

The sword lily *Gladiolus imbricatus* L. is a clonal plant creating underground tubers performing the role of storage and regenerative organs of shoot origin. Leaves, usually three, the lowest 16-35cm×15mm, are obtuse, the cauline up to 5mm wide and subulate. The adult generative individuals form 30-80cm tall, leaved stalks, bearing one-sided inflorescence containing usually from several to a dozen or so purple flowers, blooming from June to July [24]. According to C. Skrypiec and A. Odintsova [25], protandry and herkogamy are revealed as the adaptations for cross-pollination. Pollination is realised as melittophily (by bees *Apis mellifera*) at the beginning of anthesis, and mostly as autophily at the end of anthesis. The fruit is a slightly inflated capsule containing numerous seeds dispersing in the auto-, ballisto- and anemochorous ways [26]. Detailed studies covering the shape of the seeds, presence and disposition of the wing, level of the periclinal cell walls of the seed coat and types of relief were carried out by S.L. Zhygalova et al. [27]. E. Racosy-Tican et al. [28] pointed out that the leaves of the sword lily contain vitamin C and minerals. Furthermore, A.S. Kravnych et al. [29] argued that *Gladiolus imbricatus* - when used as an anesthetic and lactogenic agent in ethnomedicine - has tonic and sedative actions.

The area of distribution of *Gladiolus imbricatus* L. (Fig. 1) covers Central and Eastern Europe, the Mediterranean, Caucasia and West Siberia [30].



Fig. 1. The inflorescence of *Gladiolus imbricatus* L.

### **Publication search**

For this review, a systematic approach for synthesising information through a dedicated step-wise process for selecting available peer-reviewed literature sources was applied. We searched for peer-reviewed articles of causes of disappearance of *Gladiolus imbricatus* populations using the ISI Web of Science (All Databases) and Scopus-indexed publications. These search engines were selected as they provide a comprehensive all-encompassing database for various interdisciplinary domains, including environmental sciences. The review focused on peer-reviewed literature documenting the disappearance of *Gladiolus imbricatus* localities published over the time interval from the years 1950 to 2018. Moreover, publications were searched for by browsing the Google Scholar internet search engine. We used factorial combinations of the following keywords in the searches: ("*Gladiolus imbricatus*", "sword lily", "marsh gladiolus") and ("locality", "land abandonment", "fertilisation", "drainage", "urbanisation", "succession", "transformation of vegetation", "anthropopresion", "herbivore", "pathogen"). The selection terms were examined from the title, abstract, and keywords of the articles. The results included 11 hits from the ISI Web of Science (All Databases), 17 hits from Scopus and 1470 from the Google Scholar internet search engine on 19 October 2018. After the removal of grey literature (master theses, dissertations, reports, conference proceedings and notes) from the lists of searches, we selected books and articles based on the scope which led to 2 articles through the ISI Web of Science, 6 through Scopus and 131 from the Google Scholar internet search engine. Following the removal of duplicates and an initial review of abstracts from all searches, a final total of 80 studies were selected to be reviewed.

## **Results**

### ***The survey of natural localities of Gladiolus imbricatus***

The majority of populations of *Gladiolus imbricatus* L. occur in meadows. They were observed particularly in humid lowland meadows [31-53], montane hay-meadows [54-62], tall herb meadows [63-66], as well as flooded meadows [67, 68]. Moreover, populations of *Gladiolus imbricatus* were found in peat bogs [69-70]. Many researchers noticed populations in forests, especially oak forests [71-75], hornbeam forests [34], riparian forests [76], alder forests [77], as well as burn-over and clear cut forests [78]. Other authors noted individuals of sword lily in oats and barley fields [79-84], as well as phytocoenoses dominated by *Calamagrostis epigejos* and *Carex brizoides* [50, 85].

### ***The survey of causes of the disappearance of Gladiolus imbricatus from natural localities***

The gathered articles enabled dividing the major causes of the disappearance of *Gladiolus imbricatus* from natural localities into the following: the lack of use of semi-natural communities, the inappropriate agricultural use of *Molinion caeruleae* meadows, the expansion of urbanisation and the damage of *Gladiolus imbricatus* individuals by herbivores and pathogens.

### ***The lack of use of semi-natural communities***

The abandonment of *Molinia* meadows promoting rapid secondary succession and habitat fragmentation reversion of many wet meadows into *Carex* or *Phragmites* swamps, *Salix* or *Alnus* thickets, as well as woodlands has contributed to reduction of population abundance of sword lily. The diminishing abundance of *Gladiolus imbricatus* as a result of secondary succession in *Molinia* meadows was observed inter alia by D. Michalska-Hejduk and D. Kopeć [86], T. Wójcik and M. Janicka [87] as well as M. Ziąja and T. Wójcik [88]. Other authors have also noticed the decreasing share of juvenile individuals in overgrown patches [89, 90]. Such a phenomenon is caused by lack of gaps in the continuous plant cover and litter layer considered as safe sites for seedling recruitment. The successful seedling recruitment in openings with different size and

origin was observed by several authors [91-94]. *P. Kubíková and M. Zeidler* [40], has proven that mowing in patches of *Molinion caeruleae* contributes to the appearance of juvenile individuals and to an increase in population abundance. On the other hand, the sowing experiment of *Ü. Jõgar and M. Moora* [95] produced evidence that mulching contributes to greater seedling recruitment than mowing. In light of the above-mentioned studies, it might be concluded that the opportunity of seedling recruitment beneath the litter layer could contribute to the persistence of *Gladiolus imbricatus* populations even in overgrown sites. Additionally, *O. Valkó et al.* [96] noted the lack of *Gladiolus imbricatus* seedlings emerging from soil samples taken in early spring from *Molinion* meadows.

Populations of *Gladiolus imbricatus* occurring in *Potentillo albae-Quercetum* forests are endangered by the expansion of shrubs as an effect of lack of management [73]. The detailed observations of *A.J. Kwiatkowska et al.* [97] showed that the number of *Gladiolus imbricatus* individuals from the forest floor in thermophilous oak forests is negatively correlated with density and size of *Carpinus betulus* saplings. Also, *S. Hänel and F. Müller* [34] pointed out that the increasing shade in woodland habitats, as a consequence of the abandoning of coppice, and middle-storey management, is one of main causes of the disappearance of sword lily populations.

#### ***The inappropriate agricultural use of Molinion caeruleae meadows***

Patches of *Molinion caeruleae* have suffered from intensive agricultural use. In the last few decades a decrease of abundance of individuals of *Gladiolus imbricatus* due to fertilizer application was discovered by *B. Gryzielec* [98]. The important factor for maintaining purple moor-grass meadows is seasonal variability of the moisture regime caused by fluctuations of the groundwater table (it is higher in spring and autumn and lower in summer). Therefore, the serious threat for the above-mentioned plant communities is drainage affecting the lowering of the groundwater table and the transformation of patches into highly productive meadows from the alliance *Arrhenatherion*. In effect, the most sensitive species such as *Gladiolus imbricatus* are disappearing [99]. *T. Nowak et al.* [100] pointed to periodic burning off as being another factor threatening its populations. The sowing experiments of *Ü. Jõgar and M. Moora* [95] showed weak recruitment of seedlings *Gladiolus imbricatus* in burnt locations.

#### ***The expansion of urbanisation***

Several authors [100,101] have pointed out that another factor threatening populations is the expansion of urbanisation and the proximity of many communication routes combined with the devastation of land by cross-country vehicles.

The localities of *Gladiolus imbricatus* are threatened due to anthropogenic impact and excessive penetration of the sites. The shoots bearing ornamental inflorescences are exposed to picking by tourists and flower-sellers. Also, whole individuals of sword lily are frequently dug out from natural localities and transplanted into garden cultivations. These frequently occurring phenomena contributes to the destruction of populations.

#### ***The individual reasons***

The individual reasons might be connected inter alia with susceptibility to activity of herbivores or pathogens. A very serious threat to populations of *Gladiolus imbricatus* is the physical damage to the tubers observed by *M. Cantor and T. Tolety* [102]. The aforementioned authors argue that the tubers of the species from the gender *Gladiolus* are a highly nutritious food for rodents. According to *C. Nicolae-Dănescu* [103] and *N.W. Ellis* [104] and literature cited therein], individuals of *Gladiolus imbricatus* might be infested by *Puccinia gladioli* and *Urocystis gladiolicola*. Furthermore, *A.E. Protsenko* [105] found aster yellows virus in homogenates of parts of *Gladiolus imbricatus*. Moreover, the aboveground parts of the sword lily might be damaged by livestock animals. Monitoring of populations under different management regimes showed that sheep damage significantly more shoots than cattle [106].

The decrease of abundance of sword lily populations might be result of individual causes connected with generative reproduction such as low pollen viability. *M.A. Chertkova* [107]

observed, that pollen of *Gladiolus imbricatus* germinates neither on artificial media nor on the stigma of flower pistil.

## Discussion

Although *Gladiolus imbricatus* might occur in numerous plant communities, the abundance of populations has been declining in recent decades. Similarly, it should be pointed out, that the aforementioned environmental factors (transformations of vegetation on unmanaged lands), anthropogenic agents (inappropriate meadow management, expansion of urbanisation, depletion of population resources) as well as individual causes might be also considered as serious threats for other meadow taxa.

Land abandonment might bring disastrous consequences for semi-natural communities such as *Molinion caeruleae* meadows [4, 86,108-112]. The unmanaged patches are subjected to secondary succession, leading to gradual encroachment of native and alien tall-growing macroforbs (e.g. *Filipendula ulmaria*, *Lysimachia vulgaris*, *Solidago canadensis*), tall growing rhizomatous grasses (e.g. *Phragmites australis*), large-tussock grasses and sedges (e.g. *Deschampsia caespitosa*, *Molinia caerulea*), as well as shrubs and trees (e.g. *Betula pendula*, *Salix cinerea*, *S. rosmarinifolia*), that contributes to habitat fragmentation. The disappearance of rare species from meadows as a result of successional changes was observed in numerous localities [1]. The detailed observations showed the reduction of population abundance and plant performance in *Gentiana pneumonanthe* [113-115], *Dianthus superbus* [116], *Iris sibirica* [117, 118] and *Trollius europaeus* [119-121]. The aforementioned authors highlighted the increased trend toward senilisation of populations along the gradient of meadow overgrowing and vegetation height due to successional closure of plant cover, preventing seedling recruitment.

In addition, the deterioration of the population state of the aforementioned species in effect of too intensive meadow drainage [122-126]. *D. Van der Hoek and K.W. Sykora* [127] added that it may trigger a shift into drier and more nutrient-poor plant communities. *C.J.F. Ter Braak and J. Wiertz* [128] found that drainage and acidification of *Molinion caeruleae* patches contributes to decrease of abundance of rare species such as *Parnassia palustris*, *Selinum carvifolia* and *Ophioglossum vulgatum*. At the same time, the deterioration of condition of population of numerous meadow species has been observed in effect of intensive mowing and/or fertilizer addition [98, 123, 129].

Similarly, the depletion of population resources of several plant species (e.g. *Gentiana pneumonanthe*, *Iris sibirica*, *Dianthus superbus*) in effect of expansion of urbanisation [102,126], as well as stem cutting or removal of individuals [118, 130-134] was frequently noticed.

Moreover, it is worth mentioning that the aforementioned species (similarly to *Gladiolus imbricatus*) are prone to pathogen and herbivore activity. Their species-specific influence was repeatedly recorded. Most frequently the attack of herbivores and pathogens results in damage to flowers, fruits and diaspores and the decrease of the germination process. Such a phenomenon was observed in, *Trollius europaeus* [135,136], *Gentiana pneumonanthe* [137], as well as *Dianthus superbus* [138-140]. Also, the damage of vegetative parts of individuals of the aforementioned taxa was often observed [141-145].

## Conclusions

Performed survey of publications confirmed the variability of habitat conditions suitable for development of populations of sword lily. Populations have been found in considerable range of habitats: from meadows via forests to arable fields. Moreover, the conducted literature review showed that populations of *Gladiolus imbricatus* are threatened by transformations of vegetation as an effect of land abandonment or its too intensive use. Less frequently mentioned threats are

the expansion of urbanisation, herbivorous animals' activity and pathogen infestation, as well as low pollen viability. The removal of environmental and anthropogenic threats will contribute to more effective protection of populations of sword lily and other endangered meadow species with similar habitat requirements.

## References

- [1] M. Myśliwy, B. Bosiacka, *Disappearance of Molinio-Arrhenatheretea meadows diagnostic species in the Upper Płonia River valley (NW Poland)*, **Polish Journal of Environmental Studies**, **18**(3), 2009, pp. 513–519.
- [2] K. Towpasz, A. Stachurska-Swakoń, *Occurrence of Sesleria uliginosa (Poaceae) in the communities of the Caricetalia davallianae order in the Nida Basin territory (Małopolska Upland)*, **Fragmenta Floristica et Geobotanica, Series Polonica**, **16**(2), 2009, pp. 305–316.
- [3] K. Kostrakiewicz-Gierałt, *Threats, persistence and conservation of rare plant populations in Molinion caeruleae meadows*, **Endangered Species. Threat, Conservation and Future Research**, (Editor: M. Quinn), Nova Publishers, New York, 2016, pp. 1–18.
- [4] B. Babczyńska-Sendek, *Significance of protection of the meadow and grassland communities for maintenance the floristic diversity in the area of the south-eastern Silesian Upland (Poland)*, **Biodiversity Research and Conservation**, **13**, 2009, pp. 49–60.
- [5] K. Towpasz, A. Stachurska-Swakoń, *Seslerio uliginosae-Scorzoneretum purpureae (Festuco-Brometea class) in the Nida Basin (Małopolska Upland) after 90 years*, **Acta Societatis Botanicorum Poloniae**, **81**(3), 2012, pp. 167–173.
- [6] K. Kostrakiewicz-Gierałt, A. Stachurska-Swakoń., K. Towpasz, *Variability of morphological traits of the rare plant species Angelica palustris (Apiaceae) in managed and abandoned meadows: effect of mowing*, **Polish Journal of Ecology**, **66**(1), 2018, pp. 36–47.
- [7] K. Kostrakiewicz-Gierałt, *The impact of disturbance gradient on recruitment of clonal plant species in Molinietum caeruleae meadows*, **Polish Journal of Ecology**, **61**(3), 2013, pp. 519–533.
- [8] K. Kostrakiewicz-Gierałt, *The effect of neighbouring plant height, disturbance level and gap size on spontaneous recruitment of large-seeded and small-seeded species in Molinietum caeruleae meadows*, **Polish Journal of Ecology**, **62**(2), 2014, pp. 289–306.
- [9] B. Barabasz-Krasny, K. Możdżeń, A. Sołtys-Lelek, A. Stachurska-Swakoń, *The allelopathic potential of Cirsium oleraceum (L.) Scop into the fodder meadow plants*, **Notulae Botanicae Horti Agrobotanici**, **45**(1), 2017, pp. 255–261.
- [10] J.K. Combs, A.M. Lambert, S.H. Reichard, *Predispersal seed predation is higher in a rare species than in its widespread sympatric congeners (Astragalus, Fabaceae)*, **American Journal of Botany**, **100**(11), 2013, pp. 2149–2157.
- [11] A. Stachurska-Swakoń, B. Barabasz-Krasny, A. Klasa, A. Palaczyk, *Reduced plant fitness by pre-dispersal seed predation in the threatened plant species Cirsium decussatum*, **Seed Science Research**, **28**(2), 2018, pp. 123–130.
- [12] Z. Münzbergová, *Determinants of species rarity: Population growth rates of species sharing the same habitat*, **American Journal of Botany**, **92**, 2005, pp. 987–1994.
- [13] \* \* \*, *Regulation of the Minister of the Environment of 9 October 2014 on the species-specific protection of plants*, **Journal of Laws RP**, **2014**, item 1409, 2014, Cancellary of Prime Minister, Warsaw.
- [14] L.V. Semerenko, T.K. Morozova, 2006. *Gladiolus imbricatus L.*, **Red Data Book of the Republic of Belarus**. <http://redbook.minpriroda.gov.by/plantsinfo> [assessed on 10.10.2018].

- [15] J. Holub, F. Proházka, *Red List of vascular plants of the Czech Republic*, **Preslia**, **72**, 2000, pp. 167-186.
- [16] V. Lilleleht, **The Red Data Book of Estonia. Threatened Plants, Fungi and Animals**, ETA, Looduskaitse Komisjon, Tartu, Estonia, 1998, p. 150.
- [17] \* \* \*, **La Liste Rouge des Espèces Menacées en France**. Comité français de l'UICN, Fédération des conservatoires botaniques nationaux, Muséum national d'Histoire naturelle, Paris, France, 2012, p. 34.
- [18] G. Király, **List of the Vascular Flora in Hungary**, Sajátkiadás, Sopron, Hungary, 2007, p. 73.
- [19] V. Rašomavičius, **Red data book of Lithuania**, Leidykla Lututė, Kaunas, Lithuania, 2007, p. 615.
- [20] C. Bornand, A. Gygax., P. Juillerat, M. Jutzi, A. Möhl., S. Rometsch, L. Sager, H. Santiago, S. Eggenberg, **Liste Rouge Plantes Vasculaires. Espèces Menacées en Suisse**, Office Fédéral de L'environnement, Berne et Info Flora, Genève, Switzerland, 2016, p. 178.
- [21] A.P. Diduh, **Red data book of Ukraine**, Globalkonsulting, Kïiv, Ukraine, 2009, p. 912.
- [22] M. Schnittle, K.F. Günther, *Central European vascular plants requiring priority conservation measures- an analysis from national Red Lists and distribution maps*, **Biodiversity and Conservation**, **8**, 1999, pp. 891-925.
- [23] P. Turis, J. Kliment, V. Feráková, D. Dítě, P. Eliáš, R. Hrivnák, J. Košťál, R. Šuvada, P. Mráz, D. Bernátová, *Red list of vascular plants of the Carpathian part of Slovakia*, **Thaiszia**, **24**(1), 2014, pp. 35-87.
- [24] \* \* \*, **eMonocot**, <http://e-monocot.org/taxon/urn:kew.org:wcs:taxon:328505> [assessed 24.10.2018].
- [25] C. Skrypiec, A. Odintsova, *Flowering and pollination traits in *Gladiolus imbricatus* L.*, **Naukowi Zapiski Tiernopilskowo Nacionalnowo Uniwiersitetu im. W. Gnatiuka, Seria Biologia**, **61**(4), 2014, pp. 37-42.
- [26] Ch. Skrypiec., A. Odintsova, *Fruit and seed morphology in *Iris sibirica* L. and *Gladiolus imbricatus* L. in relation with the modes of dissemination*, **Biological Systems**, **7**(1), 2015, pp. 93-96.
- [27] S.L. Zhygalova, O.A. Futorna, A. Levantes *Micromorphological study (ultrastructure of lamina surface, seeds, ultrasculpture of pollen grains) of *Gladiolus* L. species (Iridaceae Juss.) of Ukrainian flora*, **Environmental and Socio-Economic Studies**, **2**(4), 2014, pp. 21-27.
- [28] E. Racosy-Tican, B. Bors, A-M. Szatmari, *In vitro culture and medium-term conservation of the rare wild species *Gladiolus imbricatus**, **African Journal of Biotechnology**, **11**(81), 2012, pp. 14703-14712.
- [29] A.S. Krvavych, R.T. Konechna, R.O. Petrina, M.S. Kyrka, N.L. Zayarnuk, R.M. Gulko, N.E. Stadnytska, V.P. Novikov, *Phytochemical research of plant extracts and use in vitro culture in order to preserve rare wild species *Gladiolus imbricatus**, **Research Journal of Pharmaceutical, Biological and Chemical Sciences**, **5**(1), 2014, pp. 240-246.
- [30] E. Hultén, M. Fries, **Atlas of North European Vascular Plants. North of the Tropic of Cancer**, vol. I-III, Koeltz Scientific Books, Königstein, Germany, 1986, p. 1172.
- [31] M. Höhn, *Vascular flora of the Kelemen (Calimani) Mts on the side of the Maros (mures) river drainage area*, **Studia Botanica Hungarica**, **27-28**, 1998, pp. 75-108.
- [32] A-M. Csörgő, J-P. Frink, *Some phytocoenological and population structure features of *Fritillaria meleagris* L. In the Upper Șard valley (Cluj County, Romania)*, **Contribuții Botanice**, **38**(2), 2003, pp. 163-172.
- [33] J. Kołodziejek, D. Michalska-Hejduk, *Geobotanic characteristic of the purple moor-grass meadow community *Molinietum caeruleae* on the clearings in the northern part of the*

- Silesia voivodeship, **Fragmenta Floristica et Geobotanica, Series Polonica**, **11**, 2004, pp. 141–155.
- [34] S. Hänel, F. Müller, *Distribution, phytosociology and ecology of *Gladiolus imbricatus* L. in Saxony*, **Hercynia**, **39**(1), 2006, pp. 69–87.
- [35] K. Piątek, *Protected and threatened vascular plants of the neighbourhood of Jodłowa in the Pogórze Ciężkowickie Hills (SE Poland)*, **Chrońmy Przyrodę Ojczyść**, **63**(6), 2007, pp. 65–74.
- [36] M. Podgórska *The protected, threatened and rare vascular plant species in the Garb Gielniowski Hump (Wyżyna Małopolska Upland)*, **Fragmenta Floristica et Geobotanica**, **14**(1), 2007, pp. 61–74.
- [37] A. Rombel-Bryzek, *The locality of *Gladiolus imbricatus* L. in Landscape Park Chełmy on the Pogórze Kaczawskie Foothills*, **Chrońmy Przyrodę Ojczyść**, **63**(1), 2007, pp. 101–105.
- [38] D. Bochnak, *Populations status of rare vascular plants in *Molinietum coeruleae* association in vicinity of Tyniec and Sidzina*, **Chrońmy Przyrodę Ojczyść**, **27**(3), 2011, pp. 210–217.
- [39] I.K. Dembicz, A. Kapler, Ł. Kozub, P. Zaniewski, *New locality of *Trollius europaeus* L. and *Gladiolus imbricatus* L. near Sochocin by Płońsk (Central Poland)*, **Opole Scientific Society Nature Journal**, **44**, 2011, pp. 36–46.
- [40] P. Kubíková, M. Zeidler, *Habitat demands and population characteristics of the rare plant species *Gladiolus imbricatus* L. in the Frenštát region (NE Moravia, the Czech Republic)*, **Acta Musei Silesiae, Scientiae Naturales**, **60**, 2011, pp. 154–164.
- [41] J. van der Veen, *Year-round grazing as a tool for rural landscape management and tourism development: two examples from Latvia*, **Nordic - Baltic - Belarus Solutions in Farming for Biodiversity**, (Editor: Jānis Reihmanis), Latvian Fund for Nature, Rīga, Latvia, 2011, pp. 109–122.
- [42] T. Kowalczyk, *Rare and interesting vascular plant species in the vicinity of Libiąż (Śląska Upland)*, **Fragmenta Floristica et Geobotanica**, **19**(1), 2012, pp. 177–179.
- [43] P. Evarts-Bunders, G. Evarte-Bundere, J. Bāra, M. Nitcis, *The flora of vascular plants in nature reserve „Eglone”*, **Acta Biologica Universitas Daugavpilis**, **13**(2), 2013, pp. 21–38.
- [44] M. Smoczyk, *Variability and conservation status of *Molinia* meadows in south-eastern part of the Central Sudetes Mts.*, **Przyroda Sudetów**, **16**, 2013, pp. 19–34.
- [45] J. Tkáččiková, S. Kubešová, *Domorazské louky Nature Monument (Moravian Gate, Czech Republic) - bryophytes, vascular plants and vegetation*, **Acta Musei Beskidensis**, **5**, 2013, pp. 45–65.
- [46] B. Barabasz-Krasny, A. Sołtys-Lelek, K. Mozdzeń, *Phytosociological characteristics of endangered meadows adjacent to the complexes of Niepołomice Forest (Southern Poland)*, **Prądnik. Prace Muzeum im. Szafera**, **24**, 2014, pp. 65–82.
- [47] E. Schneider-Binder, *Comparative study of alluvial *Cnidion*-type meadows in the lower Danube river basin*, **Transylvanian Review of Systematical and Ecological Research**, **16**, 2014, pp. 39–54.
- [48] M. Zarzyka-Ryszka, P. Ryszka, *New localities of meadow plant species between the Vistula and Raba Rivers (northern part of the Puszcza Niepołomicka forest and the adjacent areas)*, **Fragmenta Floristica et Geobotanica**, **21**(2), 2014, pp. 377–388.
- [49] J. Holeksa, A. Błońska, A. Kompała-Bąba, G. Woźniak, P. Kurek, G. Szarek-Lukaszewska, K. Grodzińska, M. Żywiec, *Roślinność Olkuskiego Okręgu Rudnego, Przyrodnicza i historyczna wartość Olkuskiego Okręgu Rudnego*, (Editor: B. Godzik), W Szafer Polish Academy of Sciences, Kraków, Poland, 2015, pp. 129–145.
- [50] A. Kołos, *A new locality of *Gladiolus imbricatus* (Iridaceae) in the North Podlasie Lowland*, **Fragmenta Floristica et Geobotanica**, **22**(2), 2015, pp. 390–395.



- [51] M. Ziaja, T. Wójcik, *The occurrence of *Gladiolus imbricatus* (Iridaceae) in meadow communities of the Łąki w Komborni natura 2000 site (PLH180042, SE Poland)*, **Fragmenta Floristica et Geobotanica**, **23**(2), 2016, pp. 219-230.
- [52] M. Ziaja, T. Wójcik, *Floristic diversity of the "Łąki w Komborni" Natura 2000 Site PLH180042 (Western Carpathians)*, **Steciana**, **21**(2), 2017, pp. 49–57.
- [53] G.F. Peterken, **Meadows**, Bloomsbury Publishing Plc., London, UK, 2017, pp. 432.
- [54] E. Dubiel, A. Stachurska, S. Gawroński, *Zbiorowiska nieleśne Magurskiego Parku Narodowego (Beskid Niski). (Non-forest communities of the Magura National Park (Beskid Niski Mts.))*, **Zeszyty Naukowe Uniwersytetu Jagiellońskiego, Prace Botaniczne (Botanical Papers)**, **33**, 1999, pp. 1-60.
- [55] O. Zamfirescu, C. Manzu, *Comparative study of some plant communities of association *Festuco rubrae-Agrostetum capillaris* Horv.1951 from Oriental Carpathians*, **Analele științifice ale Universității "A.I. Cuza" Iași**, **49**, 2003, pp. 195-204.
- [56] A. Medwecka-Kornaś, *Vegetation of the Gorce Mts. former and present studies*, **Ochrona Beskidów Zachodnich**, **1**, 2006, pp. 23–32.
- [57] M. Kozak, *Differentiation of the meadow communities in the Gorce mountain range (Polish Western Carpathians)*, **Botanical Papers**, **41**, 2007, pp. 1-174.
- [58] J. Špulerová, *Succession changes in extensively used agricultural land*, **Ekológia (Bratislava)**, **27**(1), 2008, pp. 54–64.
- [59] Z. Mirek, A. Nikel, Ł. Wilk, *The most abundant population of *Gladiolus imbricatus* (Iridaceae) in the Tatra National Park*, **Fragmenta Floristica et Geobotanica, Series Polonica**, **21**(2), 2014, pp. 392-395.
- [60] D. Babai, A. Tóth, I. Szentir, M. Biró, A. Máté, L. Demeter, M. Szépligeti, A. Varga, A. Molnár, R. Kun, Z. Molnár, *Do conservation and agri-environmental regulations effectively support traditional small-scale farming in East-Central European cultural landscapes?* **Biodiversity and Conservation**, **24**(13), 2015, pp. 3305–3327.
- [61] M. Slámová, P. Jančura, V. Fabriciusová, B. Beláček, K. Zrníková, Z. Pridavková, *Traditional agricultural practices, land cover diversity and biodiversity in the Southern Podpolanie Region*, **Biocultural Diversity in Europe**, (Editors: M. Agnoletti and F. Emanuelli), Springer, Switzerland, 2016, pp. 249-268
- [62] A. Ważna, J. Cichocki, J. Bojarski, G. Gabryś, *Impact of sheep grazing on small mammals diversity in lower mountain coniferous forest glades*, **Applied Ecology and Environmental Research**, **14**(3), 2016, pp. 115-127.
- [63] A. Suder, *Vegetation of wet meadows (order *Molinietalia caeruleae* W. Koch 1926) in the eastern part of Silesia Upland*, **Grassland Science in Poland**, **10**, 2007, pp. 159-172.
- [64] J. Jakubowska-Gabara, M. Kurzac, M. Kiedrzyński, D. Kopeć, L. Kucharski, J. Kołodziejek, P. Niedźwiedzki, P. Popkiewicz, P. Witosławski, K. Zielińska, *New stations of rare, protected and threatened species of vascular plants in Central Poland. Part II*, **Fragmenta Floristica et Geobotanica**, **19**(2), 2012, pp. 349-359.
- [65] V. Plášek, Š. Cimalová, *Interesting botanical findings in the area of Northern Moravia and Silesia VII*, **Acta Musei Silesiae, Scientiae Naturales**, **63**, 2014, pp. 69-82.
- [66] M. Miłkowski, J. Słupek, *The new localities of Turkish Marsh *Gladiolus imbricatus* (Iridaceae) in Radom environs (Central Poland)*, **Chrońmy Przyrodę Ojczystą**, **71**(3), 2015, pp. 236-238.
- [67] J-A. Metsoja, L. Neuenkamp, S. Pihu, K. Vellak, J.M. Kalwij, M. Zobel, *Restoration of flooded meadows in Estonia –vegetation changes and management indicators*, **Applied Vegetation Science**, **15**, 2012, pp. 231–244.
- [68] T. Talvi, T. Talvi, **Semi-Natural Communities. Preservation and Management**. Ministry of Agriculture. Viidumäe-Tallin, Estonia, 2012, p 31.
- [69] A. Kołos, B. Matowicka, *Monotoring zagrożonych gatunków roślin na torfowisku Rynki w Narwiańskim Parku Narodowym W*, **Różnorodność biologiczna- od komórki do**

- ekosystemu. Rośliny i grzyby w zmieniających się warunkach środowiska**, (Editors: I. Ciereszko and A. Bajguz), Polskie Towarzystwo Botaniczne, Oddział w Białymstoku, 2013, pp. 155-168.
- [70] M. Smoczyk, M. Karakula, *Rare and threatened vascular plant species in the Bystrzyckie Mts and the Polish part of Orlickie Mts (Central Sudetes)-Part 5*, **Przyroda Sudetów**, **19**, 2016, pp. 13-44.
- [71] G. Mezősi, I. Bárányi-Kevei, R. Géczi, *The future ecological value of the Hungarian landscape*, **Acta Geographica Szegediensis**, **35**, 1994-95, pp. 21-43.
- [72] J. Jakubowska-Gabara, *Materials for vascular flora of forests in environs of Sieradz and Zduńska Wola*, **Acta Universitatis Lodziensis, Folia Botanica**, **7**, 1990, pp. 3-34.
- [73] J. Jakubowska-Gabara, *Plant cover of "Półboru" reserve and their changes during ten years*, **Acta Universitatis Lodziensis, Folia Zoologica**, **4**, 1995, pp. 93-122.
- [74] H. Piękoś-Mirkowa, Z. Mirek, **Flora Polski. Rośliny chronione**, Multico, Warsaw, Poland, 2006, p. 417.
- [75] P. Kalinowski, *Rare vascular plants of the Podlasie Nadbużańskie region (eastern Poland) – part 1. Grassland, meadow and wetland plants*, **Fragmenta Floristica et Geobotanica**, **19**(2), 2012, pp. 361-377.
- [76] K. Piórek, J. Krechowski, *Rich stand of *Gladiolus imbricatus* L. in the Nadbużański Landscape Park (Nizina Południowopodlaska Lowland)*, **Chrońmy Przyrodę Ojczyzną**, **65**(3), 2009, pp. 201-204.
- [77] C. Drăgulescu, *The hydrophilous flora and vegetation of the Timiș drainage basin (Banat, Romania)*, **Transylvanian Review of Systematical and Ecological Research**, **15**, 2013, pp. 61-88.
- [78] T. Kull, T. Kukk, M. Leht, H. Krall, Ü. Kukk, K. Kull, V. Kuusk, *Distribution trends of rare vascular plant species in Estonia*, **Biodiversity and Conservation**, **11**(2), 2002, pp. 171-196.
- [79] S. Michalik, *Ważniejsze biocenozy polan i hał*, **Gorce**, (Editor: S. Michalik), Wiedza Powszechna, Warszawa, Poland, 1989, pp. 136-143.
- [80] A. Nikel, *Gatunki rzadkie, zagrożone i chronione w Nowym Sączu*, **Fragmenta Floristica et Geobotanica, Series Polonica**, **9**(1), 2002, pp. 135-140.
- [81] A. Nikel, *Gatunki ginące i zagrożone na terenie części projektowanego Spiskiego Parku Krajobrazowego (Pogórze Spiskie, Polskie Karpaty Zachodnie)*, **Fragmenta Floristica et Geobotanica, Series Polonica**, **11**(2) 2004, pp. 281-286.
- [82] A. Nowak, A. Antonin, *Interesting locations of *Gladiolus imbricatus* (Iridaceae) in Morawska Gate*, **Fragmenta Floristica et Geobotanica, Series Polonica**, **13**(1), 2006, pp. 17-22.
- [83] Z. Kropáč, S. Mochnacký, *Contribution to the segetal communities of Slovakia*, **Thaiszia**, **19**, 2009, pp. 145-211.
- [84] T. Dąbkowska, P. Sygulska, *Variations in weed flora and the degree of its transformation in ecological and extensive conventional cereal crops in selected habitats of the Beskid Wyspowy Mountains*, **Acta Agrobotanica**, **66** (2), 2013, pp. 123-136.
- [85] M. Falkowski, *Nowe stanowisko *Gladiolus imbricatus* (Iridaceae) w dolinie środkowej Wisły*, **Fragmenta Floristica et Geobotanica, Series Polonica**, **9**(2), 2002, pp. 369-370.
- [86] D. Michalska-Hejduk, D. Kopeć, *Dynamics of semi-natural vegetation with a focus on Molinion meadows after 50 years of strict protection*, **Polish Journal of Environmental Studies**, **21**(6), 2012, pp. 1731-1741.
- [87] T. Wójcik, M. Janicka, *Current state and changes in Molinion meadows from Kostrze environs in Kraków*, **Ecological Questions**, **23**, 2016, pp. 15 - 27.
- [88] M. Ziaja, T. Wójcik, *Occurrence of the globeflower *Trollius europaeus* L. in "Łąki w Komborni" Natura 2000 site (Podkarpackie Province, SE Poland)*, **Ecological Questions**, **23**, 2016, pp. 61-69.

- [89] K. Kostrakiewicz-Gierałt, *The variability of selected features of *Gladiolus imbricatus* L. in relation to successive stages of meadow communities following the mowing cessation*, **Polish Journal of Ecology**, **62**(2), 2014, pp. 307-321.
- [90] K. Kostrakiewicz-Gierałt, *Spatio-temporal variability of *Gladiolus imbricatus* L. populations in different plant communities near Kraków*, **Ecological Questions**, **27**(3), 2017, pp. 77–87.
- [91] M. Moora, M. Kose, J. Ülle, *Optimal management of the rare *Gladiolus imbricatus* in Estonian coastal meadows indicated by its population structure*, **Applied Vegetation Science**, **10**, 2007, pp. 161-168.
- [92] K. Kostrakiewicz, *The effect of gaps on seedlings recruitment of threatened species in *Molinietum caeruleae* W. Koch 1926 patches*, **Chrońmy Przyrodę Ojczystą**, **66**(3), 2010, pp. 184–189.
- [93] K. Kostrakiewicz-Gierałt, *The impact of disturbance gradient on recruitment of clonal plant species in *Molinietum caeruleae* meadows*, **Polish Journal of Ecology**, **61**(3), 2013, pp. 519-533.
- [94] K. Kostrakiewicz-Gierałt, *The effect of neighbouring plant height, disturbance level and gap size on spontaneous recruitment of large-seeded and small-seeded species in *Molinietum caeruleae* meadows*, **Polish Journal of Ecology**, **62**(2), 2014, pp. 289-306.
- [95] Ü. Jögar, M. Moora, *Reintroduction of a rare plant (*Gladiolus imbricatus*) population to a river floodplain- How important is meadow management?*, **Restoration Ecology**, **16**, 2008, pp. 382-385.
- [96] O. Valkó, P. Török, E. Vida, I. Arany, B. Tóthmérész, G. Matus, *The role of soil seed banks in restoration of two hay meadows*, **Természetvédelmi Közlemények**, **15**, 2009, pp. 147-159.
- [97] A.J. Kwiatkowska, K. Spalik, E. Michalak, A. Palińska, D. Panufnik, *Influence of the size and density of *Carpinus betulus* on the spatial distribution and rate of deletion of forest-floor species in thermophilous oak forest*, **Plant Ecology**, **129**(1), 1997, pp. 1-10.
- [98] B. Gryzielec, *Wpływ użytkowania i nawożenia na występowanie rzadkich i zagrożonych gatunków w runi zmiennowilgotnej łąki *Selino carvifoliae*-*Molinietum**, In: T. M. Traczewska (ed.), **Interdyscyplinarne zagadnienia w inżynierii i ochronie środowiska**, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, Poland 2013, pp. 179–186.
- [99] A. Kryszak, J. Kryszak, M. Grynia, M. Czemko, *The dynamics of changes in floristic diversity of grass communities in the Obra river valley*, **Water-Environment-Rural Areas**, **61**(16), 2006, pp. 229-237.
- [100] T. Nowak, B. Węgrzynek, B. Tokarska-Guzik, *Assets and threats to *Molinia* meadows (*Molinion caeruleae* alliance) on chosen Natura 2000 areas in the eastern part of the Silesian Upland*, **Acta Scientiarum Polonorum, Seria Agricultura**, **14**(3), 2015, pp. 49-61.
- [101] J. Hereźniak, K. Pierzgałski, *Stanowiska rzadkich i chronionych gatunków roślin łąkowych na terenie Częstochowy*, **Chrońmy Przyrodę Ojczystą**, **47**(3), 1991, pp. 79-84.
- [102] M. Cantor, J. Tolety, *Gladiolus*, **Wild Crop Relatives: Genomic and Breeding Resources: Plantation and Breeding Resources, Plantation and Ornamental Crops** (Editor: Kole Chittaranjan), Springer-Verlag, Berlin, Heidelberg, Germany, 2011, pp. 133-156.
- [103] C. Nicolae-Dănescu, *Bolile gladiolelor si stanjeneilor*, **Revista of Ecology**, **22**, 2010, pp. 1-45.
- [104] N.W. Ellis, *Plant Parasites of Europe; leafminers, galls and fungi*, 2001-2018. <http://bladminerders.nl/host-plants/plantae/spermatopsida/angiosperma/monocots/asparagales/iridaceae/iridoideae/gladiolus/gladiolus-imbricatus/> [assessed on 19.10.2018]

- [105] A.E. Protsenko, *Electron microscopy of the aster yellows virus (Leptomotopus callistephi Ryzhkov)*, **Biologia Plantarum**, **1**(3), 1959, pp. 187–191.
- [106] M. Kose, M. Moorra, *Monitoring the wild gladiolus (Gladiolus imbricatus) population under different meadow management regimes*, **Coastal Meadow Management: Best Practice Guidelines** (Editors: R. Rannap, L. Briggs, K. Lotman, I. Lepik and V. Rannap), Ministry of the Environment of the Republic of Estonia, Tallinn, Estonia, 2005, pp. 70–71.
- [107] M.A. Chertkova, *Study of the pollen viability and the stigma receptivity of Gladiolus L. species in the west ural area*, **Perm Agrarian Journal**, **19**(3), 2017, pp. 18-23.
- [108] S. Gusewell, F. Klotzli, *Abundance of common reed (Phragmites australis), site conditions and conservation value of fen meadows in Switzerland*, **Acta Botanica Neerlandica** **47**(1), 1998, pp. 113-129.
- [109] C. Trąba., P. Wolański, *Floristic diversity of meadows communities representing Molinion, Cnidion dubii and Filipendulion alliances in Poland - threats and protection*, **Inżynieria Ekologiczna**, **29**, 2012, pp. 224-235.
- [110] M. Kulik, *Changes of biodiversity and species composition of Molinia meadow depending on use method*, **Polish Journal of Environmental Studies**, **3**(3), 2014, pp. 773–782.
- [111] M. Ziaja, T. Wójcik, M. Wrzesień, *Conservation status and trends in the transformation of Molinia meadows in the Łąki w Komborni Natura 2000 site, SE Poland*, **Acta Agrobotanica**, **70**(3), 2017, pp. 1-13.
- [112] G. Swacha, Z. Botta-Dukat, Z. Kącki, D. Pruchniewicz, L. Żolnierz, *The effect of abandonment on vegetation composition and soil properties in Molinion meadows (SW Poland)*, **Plos One**, **13**(5), 2018, Article Number: e0197363, DOI: 10.1371/journal.pone.0197363.
- [113] J.G.B. Oostermeijer, R. Vant Veer, J.C.M. De Nuijs, *Population-structure of the rare, long-lived perennial Gentiana pneumonanthe in relation to vegetation and management in the Netherlands*, **Journal of Applied Ecology**, **31**(3), 1994, pp. 428-438.
- [114] K. Kostrakiewicz-Gierałt, *The effect of vegetation character on abundance and structure of subpopulations of rare herb species Gentiana pneumonanthe L.*, **Polish Journal of Ecology**, **61**(1), 2013, pp. 35-43.
- [115] K. Kostrakiewicz-Gierałt, *The variability of Gentiana pneumonanthe L. subpopulations in different habitat conditions*, **Ecological Questions**, **23**, 2016, pp. 51-59.
- [116] K. Kostrakiewicz-Gierałt, *The size structure of ramets in Dianthus superbus L. in mosaic meadow vegetation*, **Acta Agrobotanica**, **66**(3), 2013, pp. 23-30.
- [117] K. Kostrakiewicz, *Population structure of a clonal endangered plant species Iris sibirica L. in different habitat conditions*, **Polish Journal of Ecology**, **56**(4), 2008, pp. 581-592.
- [118] V.M. Minarchenko, *Threatened medicinal plants of Ukraine: An assessment of the current protection status*, **Journal of Plant Development**, **24**, 2017, pp. 117-131.
- [119] K. Kostrakiewicz-Gierałt, M. Kozak, K. Kozłowska-Kozak, *The effect of different habitat conditions on temporal and spatial variation in selected population properties of the rare plant species Trollius europaeus L.*, **Biodiversity-Research and Conservation**, **39**(1), 2015, pp.67-78.
- [120] R. Kochanowska, R. Gamrat, *Zbiorowiska trawiaste z pelnikiem europejskim (Trollius europaeus L.) w dolinie rzeki Chocieli*, **Grassland in Poland**, **10**, 2007, pp. 119–129.
- [121] A. Kołos, A. Kołos, *Trollius europaeus (Ranunculaceae) in north-eastern Poland*, **Fragmenta Floristica et Geobotanica Polonica**, **23**(2), 2016, pp. 207–217.
- [122] K. Zarzycki, *O zachowanie wilgotnych łąk w dolinie górnej Wisły*, **Chrońmy Przyrodę Ojczystą**, **12**(1), 1956, pp. 11-17.
- [123] K. Zarzycki, *Humid meadows in the environs of Czernichow near Cracow deserving protection*, **Nature Conservation**, **25**, 1958, pp. 49-68.

- [124] Z. Bednarz, E. Feliksik, *Ginące stanowisko kosańca syberyjskiego i pełnika europejskiego w Sidzinie koło Krakowa*, **Chrońmy Przyrodę Ojcz.** **26(6)**, 1970, pp. 34-36.
- [125] D. Tumidajowicz, E. Zubel, *The disappearance and changes of wet meadows (*Molinion caeruleae*) in the valley of the Vistula river near Czernichów (Southern Poland)*, **Fragmenta Floristica et Geobotanica**, **24(4)**, 1978, pp. 643-650.
- [126] M. Jaźwa, *The Siberian iris (*Iris sibirica*) - A new station near Lancut (SE Poland)*, **Chrońmy Przyrodę Ojczystą**, **67(3)**, 2011, pp. 265-266.
- [127] D. der Hoek, K.W. Sykora, *Fen-meadow succession in relation to spatial and temporal differences in hydrological and soil conditions*, **Applied Vegetation Science**, **9(2)**, 2006, pp. 185-194.
- [128] C.J.F. ter Braak, J. Wiertz, *On the statistical-analysis of vegetation change - A wetland affected by water extraction and soil acidification*, **Journal of Vegetation Science**, **5(3)**, 1994, pp. 361-372.
- [129] J.G.B. Oostermeijer, J.C.M. den Nijs, L.E.L. Raijmann, S.B.J. Menken, *Population biology and management of the marsh gentian (*Gentiana pneumonanthe* L.), a rare species in the Netherlands*, **Botanical Journal of the Linnean Society**, **108(2)**, 1992, pp. 117-130.
- [130] Z. Denisiuk, *Let us safeguard the riverside along the Vistula, in Cracow*, **Chrońmy Przyrodę Ojczystą**, **63 (2)**, 1987, pp. 22-31.
- [131] Z. Denisiuk, J. Korzeniak, R. Plecha, *Meadows in Opatkowice near Cracow deserve protection*, **Chrońmy Przyrodę Ojczystą**, **51(4)**, 1995, pp. 30-35.
- [132] Z. Chełmecki, J. Korzeniak, *New localities of Siberian iris *Iris sibirica* L. in Bochnia in the Pogórze Wielickie Hills (S Poland)*, **Chrońmy Przyrodę Ojczystą**, **64(6)**, 2008, pp. 63-70.
- [133] K. Kostrakiewicz, *The state of selected populations of *Dianthus superbus* and *Gentiana pneumonanthe* in Cracow (S Poland)*, **Chrońmy Przyrodę Ojczystą**, **64(2)**, 2008, pp. 51-63.
- [134] P. Gorzelak, *New locality of *Iris sibirica* L. (Iridaceae) in Lower Silesia*, **Acta Botanica Silesiaca**, **8**, 2012, pp. 155-160.
- [135] O. Pellmyr, *The cost of mutualism: interactions between *Trollius europaeus* and its pollinating parasites*, **Oecologia**, **78(1)**, 1988, pp. 53-59.
- [136] A. Andersen, *On the Agromyzidae (Diptera) in Norway, Part 2*, **Norwegian Journal of Entomology**, **60**, 2013, pp. 39-56.
- [137] H. Roskam, S. Carbonnelle, *Annotated checklist of the gall midges from the Netherlands, Belgium and Luxembourg (Diptera: Cecidomyiidae)*, **Nederlandse Faunistische Mededelingen**, **44**, 2015, pp. 47-167.
- [138] K. Vánky, M. Lutz, *Revision of some *Thecaphora* species (Ustilaginomycotina) on Caryophyllaceae*, **Mycological Research**, **111(10)**, 2007, pp. 1207-1219.
- [139] J. Mikulík, M. Sedlářová, V. Vinter, *Pathogenic fungi on *Dianthus superbus* subsp. *superbus* and their influence on host plants germination and survival*, **Acta Universitatis Palackianae Olomucensis, Facultas Rerum Naturalium, Biologia**, **39-40**, 2002, pp. 19-25.
- [140] T. Miyake, I. Satake, K. Miyake, *Sex-biased seed predation in gynodioecious *Dianthus superbus* var. *longicalycinus* (Caryophyllaceae) and differential influence of two seed predator species on the floral traits*, **Plant Species Biology**, **33(1)**, 2018, pp. 42-50.
- [141] J.A. Parmelee, **Puccinia iridis**, **Fungi Canadenses**, **320**, 1987, pp. 1-2.
- [142] L. Suss, **Phytomyza trolliicaulis* sp. n. (Diptera Agromyzidae) minatrice di *Trollius europaeus* (Ranunculaceae)*, **Bollettino di Zoologia Agraria e di Bachicoltura**, **21**, 1989, pp. 1-6.

- [143] J.D. Hitchmough, *Effects of sward height, gap size, and slug grazing on emergence and establishment of *Trollius europaeus* (Globeflower)*, **Restoration Ecology**, **11**(1), 2003, pp. 20-28.
- [144] S. Pakalniškis, *The Agromyzidae (Diptera) feeding particularities on some genera of Ranunculaceae*, **Latvijas Entomologs**, **41**, 2004, pp. 93-99.
- [145] K. Bensch, U. Braun, J.Z. Groenewald, P.W. Crous, *The genus *Cladosporium**, **Studies in Mycology**, **72**(1), 2012, pp. 1–401.
- 

*Received: January 17, 2018*

*Accepted: November 03, 2018*